DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the approach of mounting a semiconductor chip on the circuit board through thermosetting resin especially, about the mounting approach of a semiconductor chip.
[0002]
[Description of the Prior Art] One of the techniques which mounts a semiconductor chip directly on the circuit board has flip chip mounting. By this flip chip mounting, the above-mentioned projection electrode and the electric conduction pattern on the front face of the circuit board are connected by carrying out face down mounting of the semiconductor chip which comes to prepare a projection electrode in a component forming face to the component side of the circuit board. It connects with a mechanical by the approach of mounting a semiconductor chip on the circuit board through resin also especially in this, without basing the above-mentioned projection electrode and an electric conduction pattern on fused junction, such as alloying. For this reason, the connection condition of a projection electrode and an electric conduction pattern is not influenced by the differential thermal expansion of the circuit board and a semiconductor chip, and the dependability of connection can be acquired.
[0003] As an example in the case of performing mounting by such mechanical connection, first, printing spreading of the thermosetting resin is carried out on the circuit board, or thermosetting resin is imprinted on a semiconductor chip. And a semiconductor chip is pressurized to the component side of the circuit board through this thermosetting resin, and the electric conduction pattern of the circuit board and the projection electrode of a semiconductor chip are connected. Then, thermosetting resin is heated and stiffened even from a room temperature to the curing temperature. Moreover, in addition to this, in case a semiconductor chip is pressurized to the circuit board through thermosetting resin, there is also a method of making coincidence heat and harden thermosetting resin even to the curing temperature.
[0004]
[Problem(s) to be Solved by the Invention] However, there are the following technical problems in the above-mentioned mounting approach. That is, thermosetting resin is once hypoviscosity-ized before the hardening initiation temperature in the temperature up process from a room temperature to the curing temperature. However, by the above-mentioned mounting approach, since the temperature up of the thermosetting resin is carried out at a stretch from a room temperature to curing temperature, the time amount which thermosetting resin has hypoviscosity-ized in the above-mentioned temperature up process turns into ultrashort time amount.
[0005] For this reason, hardening of thermosetting resin will be started, escaped [finish] from internal gas. Moreover, by the above-mentioned mounting approach, the circuit board is also heated in connection with the temperature up of thermosetting resin, and and gas, such as a steam and a solvent, occurs from the heated circuit board. This gas is involved in into the hypoviscosity-ized thermosetting resin. However, since the time amount which thermosetting resin has hypoviscosity-ized is short as mentioned above, hardening of thermosetting resin will be started, with this gas involved in. When the

air bubbles of the above-mentioned gas will remain in the thermosetting resin after the completion of hardening and these air bubbles expand like a subsequent heat process the above result, this becomes the factor which destroys thermosetting resin, i.e., a mounting part.

[0006] Furthermore, the thermosetting resin concerned cannot fully spread on the circuit board and a semiconductor chip, and bond strength sufficient between a semiconductor chip and the circuit board cannot be obtained because the time amount which thermosetting resin has hypoviscosity-ized is ultrashort time amount.

[0007]

[Means for Solving the Problem] This invention for solving the above-mentioned technical problem is the approach of mounting a semiconductor chip through thermosetting resin on the circuit board. And the mounting approach concerning claim 1 of this invention is characterized by performing the following three processes. That is, at the 1st process, heating maintenance of the wrap thermosetting resin is carried out for the component side of the circuit board at the 1st temperature lower than the hardening initiation temperature. At the 2nd following process, where it is beyond hardening initiation temperature and said thermosetting resin is heated to the 2nd temperature of under hardening recommendation temperature, a semiconductor chip is pressurized through the thermosetting resin concerned to the component side of said circuit board. At the 3rd process, said thermosetting resin is stiffened after that.

[0008] By the approach concerning above-mentioned claim 1, heating maintenance of the thermosetting resin is carried out on the component side of the circuit board at the 1st temperature lower than the hardening initiation temperature, and it is maintained at the condition that the thermosetting resin concerned hypoviscosity-ized. For this reason, while thermosetting resin can fully extend on the component side of the circuit board, it generates from the gas and the circuit board in thermosetting resin, and degasifying of the gas involved in into the hypoviscosity-ized thermosetting resin is fully carried out. And since said thermosetting resin is heated by the 2nd temperature exceeding hardening initiation temperature in case a semiconductor chip is pressurized through thermosetting resin to the component side of said circuit board, a certain amount of viscosity will be maintained by thermosetting resin. For this reason, a semiconductor chip is pressurized to the circuit board, without involving in the gas which occurs from said circuit board by which the temperature up was carried out with heating of thermosetting resin into the thermosetting resin concerned. Therefore, thermosetting resin is hardened at the 3rd process, without including air bubbles.

[0009] Moreover, the mounting approach concerning claim 4 of this invention is characterized by performing the following three processes. namely, the 1st temperature lower than hardening initiation temperature at the 1st process -- heating -- maintenance -- ************** -- one principal plane of a semiconductor chip -- a wrap. At the 2nd following process, where it is beyond hardening initiation temperature and said thermosetting resin is heated to the 2nd temperature of under hardening recommendation temperature, said semiconductor chip is pressurized through the thermosetting resin concerned to the component side of the circuit board. At the 3rd process, said thermosetting resin is stiffened after that.

[0010] By the approach concerning above-mentioned claim 4, since heating maintenance of the wrap thermosetting resin is carried out at the 1st temperature lower than the hardening initiation temperature, while thermosetting resin can fully extend one principal plane of a semiconductor chip on the 1 principal plane of a semiconductor chip, degasifying of the internal gas has fully been carried out by thermosetting resin. And in case a semiconductor chip is pressurized through said thermosetting resin to the component side of the circuit board, said thermosetting resin is heated by the 2nd temperature exceeding hardening initiation temperature, and a certain amount of viscosity will be maintained. ** is also accumulated, and a semiconductor chip is pressurized to the circuit board, without involving in the gas which occurred from said circuit board by which the temperature up was carried out with heating of thermosetting resin into the thermosetting resin concerned. Therefore, thermosetting resin is hardened at the 3rd process, without including air bubbles.

[0011]

[Embodiment of the Invention] ** is just explained to the gestalt of the operation which applied this invention to the approach of carrying out flip chip mounting of the semiconductor chip on the circuit board hereafter based on a drawing.
[0012] (The 1st operation gestalt) Drawing 1 is process drawing for explaining an example of the mounting approach of the semiconductor chip which applied invention concerning claim 1, and explains the 1st operation gestalt using this drawing. First, at the 1st process, as shown in drawing 1 (1), the field in which the electric conduction pattern (namely, land) 2 for connecting component-side 1a of the circuit board 1, i.e., a semiconductor chip, is formed is covered with the thermosetting resin 3 for adhesion. The above-mentioned circuit board 1 comes to carry out the printed circuit of the electric conduction pattern 2 to a glass epoxy group plate or a ceramic substrate. Moreover, the insulating resin of for example, an epoxy system is used, the hardening initiation temperature is 60 degrees C, and thermosetting resin 3 presupposes that it is hardening recommendation temperature 180 degrees C. Here, suppose that hardening recommendation temperature is the temperature which a good hardening condition can be maintained [temperature] and can stiffen thermosetting resin efficiently. Suppose that thermosetting resin 3 is supplied on the mounting part of the semiconductor chip in component-side 1a by the dispensing method which used at this time, for example, a syringe, the print processes using a screen mask, etc. In addition, in case you supply thermosetting resin 3 on component-side 1a, suppose that it is not necessary to heat thermosetting resin 3, and uses at a room temperature.
[0013] Then, as shown in drawing 1 (2), the thermosetting resin 3 on the circuit board 1 is heated to the 1st temperature lower than the hardening initiation temperature (60 degrees C). Here, thermosetting resin 3 is heated, for example by laying the circuit board 1 on a hot plate by heating thermosetting resin 3 indirectly or exposing to the elevated-temperature ambient atmosphere in oven etc. Under the present circumstances, the 1st temperature of the above is set as 40 degrees C - about 50 degrees C, and suppose that thermosetting resin 3 is held 30 seconds to about 180 seconds at this 1st temperature.
[0014] next, the 2nd process shows to drawing 1 (3) -- as -- thermosetting resin 3 -- beyond hardening initiation temperature (60 degrees C) -- and it heats to the 2nd temperature of under hardening recommendation temperature (180 degrees C). Resin is chosen in the range lower than the temperature which carries out actual hardening, and presupposes preferably that it is this 2nd temperature the range near [temperature / hardening recommendation] hardening initiation temperature. Here, the 2nd temperature is set as the hardening initiation temperature (60 degrees C) of +20 degrees C - the hardening initiation temperature (60 degrees C) of about +40 degrees C as an example. And suppose that thermosetting resin 3 is held 30 seconds to about 120 seconds at this 2nd temperature.
[0015] Moreover, one principal plane (it is hereafter described as projection electrode forming face 4a) in which the projection electrode 5 of a semiconductor chip 4 is formed is made to counter to component-side 1a of the circuit board 1, and it arranges, and alignment of a semiconductor chip 4 is performed to the circuit board 1 in the meantime so that the projection electrode 5 and the electric conduction pattern 2 of the circuit board 1 may correspond. This alignment is performed by moving the semiconductor chip 4 in the condition of having carried out adsorption maintenance to a bonding tool using the bonding tool (illustration abbreviation) possessing heating and pressurization / adsorption function.
[0016] And after performing the above-mentioned alignment, and heating thermosetting resin 3 to the 2nd temperature of the above and 30 seconds to about 120 seconds' passing, as shown in drawing 1 (4), a semiconductor chip 4 is pressurized to the circuit board 1 through thermosetting resin 3. Here, suppose that the semiconductor chip 4 which carried out adsorption maintenance is pressurized to the circuit board 1, for example by the pressurization function of the above-mentioned bonding tool at the bonding tool concerned.
[0017] Then, at the 3rd process, as shown in drawing 1 (5), hardening of thermosetting resin 3 is advanced. Under the present circumstances, thermosetting resin 3 is heated to the 3rd temperature higher than the 2nd temperature of the above, maintaining at the condition of having pressurized the semiconductor chip 4 to the circuit board 1, in order to stiffen thermosetting resin 3 more for a short time. Suppose that this heating is indirectly performed through a semiconductor chip 4 by the heating

function of for example, the above-mentioned bonding tool. Suppose that it is the 3rd temperature of the above the hardening recommendation temperature (180 degrees C) of thermosetting resin 3. This becomes the approach which applied claim 2.
[0018] Moreover, as other approaches for stiffening thermosetting resin 3 more for a short time, it is a time (at for example, the time of the rate of hardening reaching to 40% - 60%) of thermosetting resin 3 hardening to some extent, and the pressurization to the circuit board 1 of a semiconductor chip 4 may be opened wide, and thermosetting resin 3 may be heated to the 3rd temperature higher than the 2nd temperature after that. Suppose that it is the 3rd temperature in this case the hardening recommendation temperature (180 degrees C) of thermosetting resin 3. This becomes the approach which applied claim 3.

[0019] With the above-mentioned 1st operation gestalt, since heating maintenance of the thermosetting resin 3 is carried out on component-side 1a of the circuit board 1 at the 1st temperature lower than that hardening initiation temperature as explained using drawing 1 (2) in the 1st process, it is maintained at the condition that thermosetting resin 3 hypoviscosity-ized on this component-side 1a. For this reason, thermosetting resin 3 can fully extend on component-side 1a of the circuit board 1. Therefore, the bond strength of the circuit board and a semiconductor chip can be obtained. Moreover, degasifying of the gas which occurred from gas and the circuit board 1 in thermosetting resin 3, and was involved in into thermosetting resin 3 is fully carried out. And as explained using drawing 1 (4) in the 2nd process, in case a semiconductor chip 4 is pressurized through thermosetting resin 3 to component-side 1a of the circuit board 1, since thermosetting resin 3 is heated by the 2nd temperature exceeding hardening initiation temperature, a certain amount of viscosity will be maintained by thermosetting resin 3. For this reason, the gas which occurs from the circuit board 1 by which the temperature up was carried out with heating of thermosetting resin 3 is not involved in into this thermosetting resin 3, and a semiconductor chip 4 is pressurized to the circuit board 1. Consequently, thermosetting resin 3 is hardened in the 3rd process explained using drawing 1 (5), without including air bubbles. Therefore, destruction of the mounting part by expansion of air bubbles can be prevented.
[0020] (The 2nd operation gestalt) Drawing 2 is process drawing for explaining an example of the mounting approach of the semiconductor chip which applied invention concerning claim 4, and explains the 2nd operation gestalt using this drawing. In addition, suppose that the same sign is given to the same component as the above-mentioned 1st operation gestalt.
[0021] At the 1st process, first, as shown in drawing 2 (1), thermosetting resin 3 is supplied in the imprint pan 10. For example, using the insulating resin of an epoxy system as this thermosetting resin 3, that hardening initiation temperature is 60 degrees C, and suppose that it is hardening recommendation temperature 180 degrees C.
[0022] Suppose the above-mentioned imprint pan 10 that it has the heater which omitted illustration here, and depth d is processed correctly. Depth d of the imprint pan 10 is the height d1 of the semiconductor chip 4 to mount. Height d2 of the projection electrode 5 It is smaller than the doubled height, and is the height d2 of the projection electrode 5. It considers as a large thing. For example, height d1 of a semiconductor chip 4 It is d1 =450micrometer and is the height d2 of the projection electrode 5. When it is d2 =30micrometer, depth d of the imprint pan 10 decides to be 30 micrometer<=d <480micrometer. And a good fillet is preferably formed in semiconductor chip 4 side attachment wall after mounting, and when a semiconductor chip 4 is put in in the imprint pan 10, depth d of the imprint pan 10 is set up so that the opening top face of the imprint pan 10 may be located about [of the height of a semiconductor chip 4] in 2/3, so that thermosetting resin 3 may not adhere to the bonding tool made to stick to the tooth back of a semiconductor chip 4 in case it is mounting. So, suppose as an example that the depth of the imprint pan 10 is set as d= 380 micrometers here.
[0023] And a rubber heater is twisted around the periphery of the syringe (illustration abbreviation) with which thermosetting resin 3 was filled up, and where the thermosetting resin 3 in a syringe is heated at this rubber heater to the 1st temperature lower than hardening initiation temperature (60 degrees C), thermosetting resin 3 is supplied in the imprint pan 10 from this syringe. Under the present circumstances, the 1st temperature of the above is set as 40 degrees C - about 50 degrees C as an

example. The thermosetting resin 3 which reduced viscosity into the imprint pan 10 is supplied without nonuniformity by this. Moreover, suppose at the imprint pan 10 that the thermosetting resin 3 more than the volume of the imprint pan 10 is fully supplied.

[0024] Then, as shown in drawing 2 (2), the thickness of the thermosetting resin 3 in the imprint pan 10 is correctly equalized by carrying out skiing JINSUGU along with the effective area of the imprint pan 10. Under the present circumstances, at the heater formed in the imprint pan 10, heating maintenance of the thermosetting resin 3 in the imprint pan 10 is carried out at the 1st temperature of the above, and suppose that thermosetting resin 3 is held 30 seconds to about 180 seconds at this 1st temperature.

[0025] Next, as shown in drawing 2 (3), projection electrode forming face 4a of a semiconductor chip 4 is turned downward, the semiconductor chip 4 concerned is ****(ed) in the thermosetting resin 3 in the imprint pan 10, and a semiconductor chip 4 is pulled up after that. It is that of a wrap about projection electrode forming face 4a of a semiconductor chip 4 in the thermosetting resin 3 in which imprinted the thermosetting resin 3 in the imprint pan 10 to projection electrode forming face 4a of a semiconductor chip 4, and heating maintenance was carried out by this at the 1st temperature lower than hardening initiation temperature. Using the bonding tool (illustration abbreviation) possessing for example, heating and pressurization / adsorption function, the imprint of the thermosetting resin 3 to such a semiconductor chip 4 performs a semiconductor chip 4, where adsorption maintenance is carried out by the rear-face side (tooth back to projection electrode forming face 4a).

[0026] Then, at the 2nd process, as shown in drawing 2 (4), in the condition of having covered projection electrode forming face 4a of a semiconductor chip 4 with thermosetting resin 3, thermosetting resin 3 is heated to the 2nd temperature by the above-mentioned imprint. Suppose that this 2nd temperature is similarly set up with having explained using drawing 1 (3) in the above-mentioned 1st operation gestalt. And suppose that thermosetting resin 3 is held 30 seconds to about 120 seconds at this 2nd temperature (80 degrees C - 100 degrees C as [Namely,] an example).

[0027] Moreover, projection electrode forming face 4a of a semiconductor chip 4 is made to counter to component-side 1a of the circuit board 1, and it arranges, and alignment of a semiconductor chip 4 is performed to the circuit board 1 so that the projection electrode 5 and the electric conduction pattern 2 of component-side 1a may correspond.

[0028] And after performing the above-mentioned alignment, and carrying out heating maintenance of the thermosetting resin 3 at the 2nd temperature of the above and 30 seconds to about 120 seconds' passing, as shown in drawing 2 (5), a semiconductor chip 4 is pressurized to the circuit board 1 through thermosetting resin 3. Here, suppose that the semiconductor chip 4 which carried out adsorption maintenance is pressurized to the circuit board 1, for example by the pressurization function of the above-mentioned bonding tool at the bonding tool concerned.

[0029] Then, at the 3rd process, as shown in drawing 2 (6), hardening of thermosetting resin 3 is advanced. Under the present circumstances, it is good to heat thermosetting resin 3 to the 3rd temperature higher than the 2nd temperature, maintaining at the condition of having pressurized the semiconductor chip 4 to the circuit board 1, in order to stiffen thermosetting resin 3 more for a short time. Suppose that this heating is indirectly performed through a semiconductor chip 4 by the heating function of for example, the above-mentioned bonding tool. Suppose that it is the 3rd temperature of the above the hardening recommendation temperature (180 degrees C) of thermosetting resin 3. This becomes the approach which applied claim 5.

[0030] Moreover, as other approaches for stiffening thermosetting resin 3 more for a short time, when thermosetting resin 3 hardens to some extent, the pressurization to the circuit board 1 of a semiconductor chip 4 may be opened wide, and thermosetting resin 3 may be heated to the 3rd temperature higher than the 2nd temperature after that. Suppose that it is the 3rd temperature in this case the hardening recommendation temperature (180 degrees C) of thermosetting resin 3. This becomes the approach which applied claim 6.

[0031] According to the approach of the above-mentioned 2nd operation gestalt, about projection electrode forming face 4a of a semiconductor chip 4, as the 1st process explained using drawing 2 (3), since wrap thermosetting resin 3 is the 1st temperature lower than the hardening initiation temperature,

viscosity is low. For this reason, thermosetting resin 3 can fully extend on projection electrode forming face 4a of a semiconductor chip 4, and the bond strength of the circuit board and a semiconductor chip can be obtained. Moreover, degasifying of the internal gas will fully be carried out by thermosetting resin 3. And as the 2nd process explained using drawing 2 R> 2 (5), in case a semiconductor chip 4 is pressurized through thermosetting resin 3 to component-side 1a of the circuit board 1, since thermosetting resin 3 is heated by the 2nd temperature exceeding hardening initiation temperature, a certain amount of viscosity will be maintained by thermosetting resin 3. For this reason, a semiconductor chip 4 is pressurized to the circuit board 1, without involving in the gas which occurred from the circuit board 1 by which the temperature up was carried out with heating of thermosetting resin 3 into thermosetting resin 3. Therefore, thermosetting resin 3 is hardened at the 3rd process explained using drawing 2 (6), without including air bubbles. Consequently, destruction of the mounting part by expansion of air bubbles can be prevented.

[0032] If took and it was in the above-mentioned 1st operation gestalt and the 2nd operation gestalt, the case where insulating resin was used as thermosetting resin was explained. However, this invention is applicable also to mounting using the anisotropy electric conduction resin containing a conductive particle.

[0033]

[Effect of the Invention] A semiconductor chip is mounted after the breadth nature of the thermosetting resin on a component side has secured by pressurizing a semiconductor chip to this component side after carrying out heating maintenance of the wrap thermosetting resin for the component-side top of the circuit board at the 1st temperature lower than that hardening initiation temperature according to the mounting approach concerning claim 1 of this invention, as explained above. Therefore, the bond strength of the circuit board and a semiconductor chip can be obtained. Thermosetting resin is hardened without starting hardening of thermosetting resin and including air bubbles with this, after fully carrying out degasifying of the internal gas. Therefore, destruction of the mounting part by expansion of air bubbles can be prevented, and it becomes possible to aim at improvement in the dependability of a mounting article.

[0034] Moreover, while the breadth nature of the thermosetting resin on the 1 principal plane of a semiconductor chip is securable by covering one principal plane of a semiconductor chip with the thermosetting resin maintained at the 1st temperature lower than hardening initiation temperature according to the mounting approach concerning claim 4 of this invention, it becomes possible to carry out degasifying of the gas in thermosetting resin. By pressurizing on the circuit board, where it heated this thermosetting resin to the 2nd temperature exceeding hardening initiation temperature after that and viscosity is raised, a semiconductor chip can be mounted on the circuit board, without involving in the gas which occurred with heating of the circuit board by the thermosetting resin concerned into the thermosetting resin concerned. While being able to obtain the bond strength of the circuit board and a semiconductor chip from the above thing, destruction of the mounting part by expansion of air bubbles can be prevented, and improvement in the dependability of a mounting article can be aimed at.

[Translation done.]